

# **SPECTRUM MANAGEMENT FOR THE 21<sup>st</sup> CENTURY**

## **A Report of the CSIS Commission on Spectrum Management**

### **Commission Cochairs**

Robert Galvin  
James Schlesinger

### **Project Director**

James A. Lewis

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Center for Strategic and International Studies  
1800 K Street, N.W., Washington, D.C. 20006  
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Fax: (202) 775-3199  
E-mail: [books@csis.org](mailto:books@csis.org)  
Web site: [www.csis.org/](http://www.csis.org/)



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# Executive Summary

U.S. spectrum management is outmoded. It has not kept pace with changes in technology and markets. New technologies and new services create immense opportunities for our nation, but an outmoded legal and management structure hobbles efforts to capture the benefits of innovation. These new technologies are not without risk, but they offer a substantial opportunity to satisfy the growing demand for new services that has produced intense competition for scarce radio spectrum.

New technologies and services have created rising demand for spectrum. Spectrum is a finite natural resource—we cannot make more—and under our current rules, demand outstrips supply. However, the same technologies that create this demand can provide a solution, by allowing more efficient use of the spectrum. This would meet existing and potential demand and could be the basis for unprecedented economic growth. Our existing organizational and legal structure, inherited from an earlier technological era, blocks the development and adoption of the new spectrum technologies. To solve the spectrum problem and exploit this technological opportunity, spectrum management must change.

The Center for Strategic and International Studies (CSIS) established a commission to assess spectrum management and consider changes in policies and procedures that would better meet the national interest (members are listed on pages 41–43). The goal was to find practical recommendations to replace the existing structure for decisionmaking with a process oriented toward long-term national objectives. This report grows out of the work of this commission. It provides an overview of the issue and recommendations on four key problems for U.S. spectrum management:

- The absence of long-range plans or a vision for spectrum use to guide policy and provide a greater degree of certainty for investors and clarity for innovators;
- The lack of an effective mechanism for resolving disputes among federal entities over spectrum policy;
- The increasing challenges in international spectrum negotiations; and
- The risks to U.S. security and economic growth from a potential lag in the development and use of new technologies.

## A New Spectrum Environment

A failure to take full advantage of wireless technologies will hurt the United States. Increased access to radio spectrum is essential for national security, public safety, and economic growth. Spectrum access enables mobility and connectivity, and demand for spectrum continues to increase in all sectors. For the military,



advantage increasingly comes from information superiority, and information superiority depends on access to spectrum. Mobile applications and networked sensors are the core of the information capabilities needed for military dominance in the twenty-first century. Operations in Kosovo required 10 times the bandwidth needed for the 1990 Gulf War, even though forces deployed to Kosovo were much smaller than those sent to the Gulf. Operations in Afghanistan and Iraq required more than 40 times the bandwidth used by the United States in the Gulf War.

Access to radio spectrum also plays a crucial role in public safety and homeland security. September 11, 2001, found responding fire and police departments at times unable to communicate with each other by radio. Expanding access and reliability for first responders and public safety networks is a crucial task. Broadcast television and radio play a critical role in the public dissemination of news and information. Safety of flight, which often depends on low-powered signals, also requires spectrum access that is protected from interference. Signals from global positioning satellites and from instrument landing systems are essential links in the air transportation network.

For the economy, technologies that exploit the radio spectrum provide competitive advantage. Industries that generate hundred of billions of dollars depend on spectrum access, and new industries continue to appear. The evolution of communications is leading to a range of new spectrum-using services that will generate intense consumer demand and increase productivity. The economic benefits of spectrum access are immense and, if the United States can organize itself to take advantage of them, a key source of future economic growth.

Innovative spectrum-based technologies are being developed at a rapid pace, and many are already deployed. Many new technologies are still experimental, but others (such as 802.11 “Wi-Fi” devices) are now mass-market commodities. This wave of innovation began with developments in military radio equipment and cellular telephones. They changed how people use spectrum. Wireless technologies developed for the military emphasize mobility, high volume, and resistance to interference in order to avoid interception and jamming. These attributes are commercially desirable as well.

Technological change has led to new ways to transmit and receive radio signals, to digitize radio transmissions and to exploit differences in time and space. This could allow for much more intensive use of the spectrum, alleviating “shortages,” and reducing the need for cumbersome regulatory practices—if research and experience show that they can operate without causing harmful interference to existing services that are valuable and often vital. However, these technologies use spectrum in a very different way than the older technologies for which U.S. spectrum policies and the regulatory structures were designed. They require a different approach to policy and regulation.

The physical characteristics of radio spectrum also intensify competition. Different parts of the spectrum have different propagation characteristics and vary widely in usefulness. Some frequencies are better than others are for mobile applications. In particular, spectrum between 100 megahertz and 3 gigahertz—the



“beachfront property”—is increasingly valuable. All of this beachfront spectrum has already been allocated.

New spectrum technologies promise to remedy this situation if we can develop policies to accommodate them. However, the pace and timing of their introduction and the interaction of spectrum-sharing devices with existing public safety, cellular telephone, and digital broadcast services pose complex management challenges. Interference parameters for spectrum-sharing technologies must be developed to ensure that critical services are not disrupted. Spectrum-sharing technologies may require us to adopt more exacting standards for receivers and transmitters. Change must be closely tied to research and testing, but once the tests are done, the United States needs a spectrum-management process that can act on the results or we will see technologies invented here first put into use somewhere else.

The existing spectrum-management structure is overwhelmed by technological change and strenuous competition. This combination of new demands and new technologies will only become more difficult, given the continuing pace of innovation. Spectrum management in the United States must change to cope with the new environment. Many other developed countries have already restructured spectrum management. The common features of these restructurings have been to streamline agencies, reduce the role of government, allow greater use of markets, and develop national spectrum plans. The United States, however, has not changed. This is not the fault of any agency or person, but the result of a process that blocks innovation. A broad range of commentators now point to the problem this creates and call for a new approach to U.S. spectrum management.

## **Recommendations to Improve Spectrum Management**

In 1934, when the Communications Act became law, Congress and the White House did not want a spectrum czar. As a result, spectrum management is divided between two agencies. The Federal Communications Commission (FCC)—an independent regulatory body that reports to Congress, not the executive branch—has authority over commercial and nonfederal spectrum use. The Commerce Department’s National Telecommunications and Information Administration (NTIA) has authority over federal spectrum use. In recent years, the two agencies have worked well together, but our concern is that the growing difficulties of spectrum management will overwhelm this divided process and complicate difficult decisions regarding safety, security, and economic growth.

The United States can improve dispute resolution, accommodate new technologies, reallocate spectrum to more beneficial uses, and safeguard important existing services. To better use a valuable resource, the CSIS commission recommends the following:

- Development by the White House of a comprehensive national strategy for spectrum that addresses economic and security issues and creates a roadmap for change;
- Establishment of a senior White House position for spectrum management and a senior-level Policy Coordinating Committee to resolve disputes



among agencies, interpret and implement policy, and ensure coordination and responsiveness;

- Concentration of responsibility for spectrum-related international activities, including the World Radiocommunication Conference, in a well-resourced ambassadorial position at the State Department;
- Creation of a White House advisory group for national spectrum issues;
- Setup of a public/private research consortium for spectrum research, to lay out a roadmap for U.S. research and development in wireless technologies and promote their adoption and exploitation—which consortium could also provide independent assessments of spectrum issues to support the White House.

### Recommendation 1. White House Oversight

The range of participants and issues involved in spectrum management—including national security, economic, diplomatic, and public safety—would leave any agency hard pressed to assert authority. Only the White House has the authority needed to resolve interagency disputes among widely disparate agencies. The White House staff, responsible for supporting the president in security and economic issues, would best perform the task of coordinating issues and stakeholders in spectrum management. For spectrum management, this requires creating a new special assistant to the president for spectrum management and establishing an interagency Policy Coordinating Committee.

#### *Special Assistant for Spectrum Management*

The special assistant should be a joint position at both the National Security Council (NSC) and the National Economic Council (NEC), given the major implications of spectrum management for both economic and security issues. The NSC and NEC provide a mechanism to manage problems, ensure broad oversight and continuity, and resolve disputes that is unmatched by other parts of government. The special assistant for spectrum management will have three primary responsibilities:

- Oversee for the president the development and implementation of a national spectrum strategy;
- Chair a new senior interagency group for spectrum management that would develop the national strategy and serve as a dispute resolution mechanism for interagency spectrum issues;
- Provide guidance, continuity, and interagency coordination for U.S. policy objectives in international spectrum negotiations.

#### *Policy Coordinating Committee for Spectrum Management*

In addition, we recommend the complementary step of creating a Policy Coordinating Committee (PCC) for spectrum management. A new, senior interagency spectrum group should draw upon senior representatives from relevant agencies (FCC, NTIA, DOD, the new Department of Homeland Security, and other agencies). This group would advise and assist the president on spectrum



policy, resolve disputes, and serve as a mechanism for coordinating policies among government entities.

PCCs provide for policy coordination among agencies, provide policy analysis for senior administration decisionmakers, and ensure timely responses to decisions. Among the PCC's most important tasks would be dispute resolution. Creating an interagency dispute resolution process would eliminate many serious spectrum-management problems faced by the United States. It also has the advantage of not requiring changes to NTIA and FCC authorities. This White House group would, like other PCCs, decide interagency disputes or escalate them to the cabinet level or the president for decision.

The president has the authority to adjudicate disputes between cabinet agencies. He does not have the same authority over the FCC, an independent regulatory body. Although this removes the commission from direct presidential oversight, it does not rule out close coordination. The Federal Reserve Board, for example, is an agency "independent within the government" that works closely with the Treasury Department to develop and implement economic and monetary policies. The United States can manage spectrum by using a similar combination of independence and coordination.

### Recommendation 2. Spectrum Advisory Board

We also recommend that the White House create a small, high-level advisory group for spectrum, composed of members selected from outside of the government. Advisory boards offer the president authoritative knowledge and insight not otherwise available on key national issues. Spectrum management has now become this sort of issue. The primary responsibilities of a Spectrum Advisory Board would be to:

- Annually assess the effectiveness of the composition and structure of spectrum regulation and make recommendations for improvement or change;
- Serve as a resource for developing long-term spectrum policies;
- Provide advice on weaknesses or deficiencies in spectrum policy and help focus agencies on future challenges.

The new Advisory Board would not have a management role. Its most important function would be to provide an impartial assessment of the interagency spectrum process. While the bifurcated interagency process currently works well, it is not ideal. We have not recommended eliminating or combining agencies, but the board would advise the president if or when this became necessary.

### Recommendation 3. Reinforce International Functions

The United States needs to treat international spectrum negotiations more seriously. There is little disagreement that the government could improve its handling of international spectrum management. International coordination of spectrum allocations is increasingly important as telecommunications and wireless markets become global—and as the United States emphasizes the use of sensors and communications technologies for its global military presence. Increased



commercial applications also mean that the nation faces economic challenges because of spectrum allocation decisions.

The International Telecommunications Union's World Radiocommunications Conference (WRC) is the most important international spectrum negotiation. WRC negotiations are shaped not only by technical requirements and commercial interests, but also by external political events that can complicate the task of the U.S. delegation. These are complex negotiations where the United States, which has only a single vote, must win the support of many other nations (who are often organized into regional blocs) to protect and advance its interests. Perseverance, resources, and an early start are crucial to success to provide time for the United States to win other nations' support before regional blocs have locked into positions on the various issues.

The United States appoints an ambassador a few months before the WRC begins to conduct negotiations. The position lasts only six months to avoid the need for Senate confirmation. The nation has been fortunate in its choice of ambassadors to the WRC, but an appointment late in the WRC cycle means they often must play catch-up with their foreign counterparts. We recommend that United States reinforce its negotiating efforts by the early appointment and confirmation of a WRC ambassador and by placing the preparation of spectrum negotiations under White House purview.

The State Department's Office of Communications and Information Policy (CIP) is led by the U.S. coordinator for international communication and information policy. The incumbent holds the rank of deputy assistant secretary and is often an ambassador. Incumbents have performed well, but there are no benefits to having two ambassadors. Our recommendation is to merge the two positions into a single, full-time, political-appointee position (the ambassadorship should not be made a career position) and for the president to appoint this ambassador at least one year before the start of the WRC to serve for the duration of an administration.

Creation of a new NSC/NEC special adviser and the Spectrum PCC will also reinforce U.S. efforts internationally and help ensure adequate support for the ambassador. The White House should demonstrate the importance of the new position by seeking amendments to the State Department's authorizing legislation to permanently establish and fund a senior ambassadorial position for spectrum negotiations.

#### **Recommendation 4. Research Support for Spectrum Innovation**

The fourth recommendation is to establish a new research consortium for spectrum, supported by both government and private sources. This is in some ways the most radical of the recommendations. We make it because of mounting evidence that research in the United States is declining, while it is continuing to increase overseas. This trend will damage U.S. economic competitiveness and security if not reversed. We also make this recommendation because of the potential for new technologies to allow for more intensive use of spectrum and overcome spectrum "shortages." Technological innovation is the only long-term



solution for spectrum access. An investment in research and development will make spectrum management easier.

Absent federal intervention, the United States may not make this investment. In the last decade, the bulk of the funding of research and development (R&D) has shifted to the private sector. Intense global economic competition means that current private-sector R&D in the United States focuses more on development of new products than on research. In contrast, foreign competitors in Europe and Asia gain an advantage from government funding for both short- and long-term basic research.

A new consortium could be organized independently or under the aegis of the National Science Foundation. By bringing leading technologists and managers together for a few months to a year or more, it would provide a resource to the government, industry, and universities for technical issues. This work should initially involve only U.S. scientists and engineers but should in the future expand to an international effort with the United States playing a leadership role.

The new consortium would be a focal point for establishing goals for technology development. It could develop and continually update a technology roadmap that would identify major research areas for spectrum. It could help identify the basic research needed for spectrum innovation (including longer-range research by universities) and participate in performing that research. The consortium could sponsor research in advanced technologies and develop new metrics for interference. The consortium would be an independent and neutral platform for testing potential conflicts between spectrum-using devices or architectures and for the development of standards. These are essential activities for increasing the efficient use of spectrum that the private sector may not adequately fund.

The changing pattern of U.S. R&D funding and the challenge of foreign competition create a long-term risk for the United States. The research consortium's mission would be to reverse this trend. Well-designed U.S. support for research, which does not duplicate or replace private-sector efforts and which involves minimal intervention in private-sector decisionmaking, could enhance U.S. research in spectrum technologies.

### **Recommendation 5. Develop a National Spectrum Strategy**

We join a number of studies on spectrum policy in calling for a national spectrum strategy. A national strategy was not necessary when there were fewer uses competing for spectrum and the technologies that used it were relatively homogenous, but this is no longer the case. Developing a strategy will be difficult in an era of commercial uncertainty and technological change, particularly with the highly diverse and competitive communities that have an interest in spectrum matters.

We propose that the strategy consider and prioritize national spectrum-management goals and identify the policies to achieve them. Creation of the spectrum-management strategy should be the responsibility of the new White House structure we have recommended. A senior advisory board and a spectrum R&D consortium could support the Spectrum PCC in developing a strategy.



In calling for a national spectrum strategy, we are not calling for central planning. A national strategy that sought to impose a centrally planned approach for spectrum use or that attempted to control spectrum allocation would make matters worse, not better. Strategy is not a pseudonym for economic planning or industrial policy. At the same time, an ad hoc or reactive approach no longer works for spectrum management. The United States cannot rely on market forces to achieve an optimal outcome for spectrum, and a national strategy will confront a series of specific issues. These include 3G, Wi-Fi, ultra-wide band, and digital broadcasting. Beyond these specifics, a few broad issues will shape a national spectrum-management strategy. A national strategy will need to:

- Balance private- and public-sector spectrum needs;
- Determine where the national interest is best served by markets and expanded property rights, by a “commons” model or by continued government control;
- Establish the pace and timing of the introduction of innovative wireless technologies;
- Protect safety-of-life services.

Each raises a series of difficult subsidiary issues, including how to meet new demands while minimizing disruption to existing services; encourage more efficient use of spectrum by both government and private-sector users; clarify incumbent rights; mesh national priorities and international negotiations; promote innovation; and decide where further deregulation is appropriate. It may take several iterations of a national strategy to work through these problems. This should not deter the effort. The national strategy should be a process for planning that establishes a regular cycle of review and revision for U.S. spectrum management.

## **Conclusion**

Spectrum management falls in a special class of political problem that is created by technological change. While technological innovation is the only long-term solution to physical constraints in the supply of spectrum, the existing management structure slows or blocks innovation. Reaping the benefit of new technologies requires reorganization, but reorganization is difficult. The objective in making these recommendations has been to focus on pragmatic, achievable goals to streamline the process for decision and reinforce consideration of broad national interests, so that the United States can begin to make the changes needed to gain the full benefits of this immense economic resource.